METHODS FOR IMPROVING THE ACCEPTABILITY OF VEGETABLES IN THE SCHOOL LUNCH PROGRAM

by

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REVIEW OF LITERATURE

Food Acceptance

In the past 20 years several studies of the acceptability of foods by various groups of people showed that a child's food acceptance pattern indicated his customary food intake, its probable nutritive value, and usually reflected his family's food habits. Vegetables were often the food least well accepted, but carrots, celery, corn, lettuce, peas, potatoes, and tomatoes had better acceptance than others.

In a survey of city-family food habits published by the Bureau of Human Nutrition and Home Economics, United States Department of Agriculture (1950), lettuce was found to be the most popular spring-time vegetable; mature onions were second. Carrots, tomatoes, and celery were eaten by one-half the families, and cabbage by one-third of them. Peas, corn, and tomatoes were the most popular canned vegetables. The higher the income of the family, the greater the use of lettuce, salad greens, asparagus, celery, and carrots. Low-income families used more cooking greens, cabbage and snap beans.

Drake and Lamb (1944) in a study of 63 families in Lubbock, Texas, found that foods most often eaten in inadequate quantities were all of the vegetables and most fruits, products made from whole grains as well as other cereal products, and milk. There was a high average consumption of eggs, citrus fruits and tomatoes. Vegetables were more often boiled than baked, steamed or creamed. Sometimes vegetables were fried. Moderate or small amounts of

water were used in cooking vegetables. Foods were usually cut into medium-sized pieces for cooking rather than left whole or cut into small pieces. Frozen foods were seldom used.

The group of leafy, green and yellow vegetables and the group of vitamin C-rich foods, including tomatoes and raw cabbage, were eaten daily by only half of the 1051 postadolescent and middle-aged Iowans studied by Eppright (1950). Mild-flavored vegetables were more acceptable than strong-flavored ones. Sweet corn and Irish potatoes were the vegetables best liked by three-fourths of these Iowans. Lettuce, tomatoes, green peas, cabbage, and celery were well liked by at least half of the group, but less than one-fourth liked cauliflower, green peppers, turnips and turnip greens, eggplant and broccoli.

Corn, celery, lettuce, potatoes and tomatoes were the vegetables best liked by pre-army California boys studied by Kennedy (1952). Vegetables included among foods receiving the lowest ratings were collards, dandelion greens, turnip greens, parsnips, rutabagas, kohlrabi, turnip roots, kale, escarole and beet tops. Reasons for non-acceptance of these food items included emotional prejudices, physiological reactions to the food, poor cooking methods, flavor dislikes and unfamiliarity. Food habits of individuals were determined by such factors as age, sex, national-racial grouping, economic status, geographical location and availability of food as influenced by processing and transportation.

Plain foods, simply cooked or in a natural state, were preferred by children studied by Davis (1933), a pediatrician in an orthopedic ward of a Chicago hospital. These children, ranging in

age from preschool to adolescent, were allowed to select their own food. They refused lettuce, tomatoes, pears and similar foods when prepared as salad, but accepted them without salad dressings. They removed bits of fruit from gelatin and custard, and raisins from rice pudding. They liked prunes, but not prune whip. Beets, lettuce, carrots and potatoes were favorite vegetables.

Radke and Caso (1948) surveyed lunches selected by pupils in the school cafeteria of the Weeks Junior High School, Newton, Massachusetts. They found that lunches most frequently lacked fruit or vegetables and that almost three-fourths of the students ate lunches which were inadequate according to the standards used in the study.

Acceptability of foods served on plate lunches is usually judged by the amount of plate waste. Driesbach (1947) in a study of nine school lunch programs concluded that the cause for most of the plate waste seemed to be the children's dislike for the food, since the size of the portions served was not excessive. The school which had the lowest waste gave a choice between two green vegetables on the complete lunch.

Baker and Ehlers (1949) listed nine factors affecting student acceptance of dishes in school cafeterias: competition among foods, appearance, location on the serving counter, name of dish, frequency of service, cost, weather, previous experience with the food, and teacher influence. Main dishes containing vegetables received lower acceptance. For example, corn pudding and corn fondue were not well received.

According to Vail (1951), foods in a school lunch were not

accepted because teachers did not accept them; a popular pupil swayed the group; there was prejudice against certain foods; some foods were considered suitable only for the underprivileged; others were considered foods for animals; some foods were unacceptable to some religious or national groups; students were unacquainted with a food or its preparation; or the food did not fit into an established meal pattern. Flavor and palatability influenced the acceptability of food. Young children are said to be especially sensitive to acids. Perhaps that accounts for the fact that they usually prefer their vegetables plain rather than mixed with a salad dressing. It may be that they like to be sure of what they are eating or that carrot sticks may be eaten from the fingers whereas a salad must be eaten with a fork.

Food choices of Nebraska children studied by Leverton and Coggs (1951) indicated that there were many foods rich in essential nutrients which a great number of the children studied did not check as "willing to eat often." Many of the children had never tasted squash, green peppers, parsnips, rutabagas or turnips. Farm children were "willing to eat often" white potatoes, raw tomatoes, lettuce, and green peas; town children checked yellow cheese, cantaloupe, and peanut butter as "willing to eat often." More farm children were unwilling to eat cooked cabbage than were town children. The workers stated that if the children selected food by preference alone, there would be danger of serious nutritional deficiencies. The results substantiate the recognized needs for widening food preferences and decreasing food prejudices as bases for improving the nutritional value of customary food

intakes and thus improving nutritional status.

Preparation of Vegetables

Children's acceptance of vegetables seemsto depend upon the method of preparation used and their familiarity with this method. Children prefer simple methods of preparation and tend to reject vegetables disguised by sauces or combined with other foods. Although foods appeal to children primarily because they enjoy their flavors and textures, foods children choose or refuse are likely to reflect choices and attitudes of someone dear to them. This imitative tendency is especially noticeable in the lower grades, but is by no means absent in higher grades and even among adults.

Vegetables and salads were accepted less readily than other menu items by 245 children in grades 1 to 12 in a rural school in Iowa (Augustine et al., 1950). Acceptance depended on method of preparation. Children in grades 1 to 3 favored buttered corn; those in grades 4 to 6 favored creamed corn. Both methods of preparation rated above scalloped corn. Both groups preferred green beans and peas buttered rather than creamed. Tomatoes were not well accepted either scalloped or stewed, but of the two methods of preparation, scalloped were preferred. Creamed and mashed potatoes were both well accepted. Irish potatoes were preferred to sweet potatoes. At least three-fourths of the children accepted salads and vegetables except for Harvard beets, creamed green beans, sweet potatoes, stewed and scalloped tomatoes.

McEnery and Suydam (1954) stated that children often prefer

canned tomatoes to fresh ones; that raw vegetables will often be eaten when the same ones cooked will be refused; and that flowerets of cauliflower or broccoli, sticks of carrot, turnip or celery, and leaves of lettuce or cabbage which the children can hold in their hands are preferred. They suggested that cooked vegetables are preferred in bite-size pieces or in a form children recognize, such as flowerets of cauliflower and thin green beans. They also stressed preserving color and texture in cooked vegetables in order to have greater acceptance.

Adult members of the family think of methods of preparation in terms of ease of preparation. Creamed vegetables take longer to prepare than buttered ones, and therefore may not be so familiar to children. This unfamiliarity may be why children prefer buttered vegetables to creamed ones, or they may dislike milk products. Three-fourths of the Iowans studied by Eppright (1950) considered butter a "very good" food, but less than one-half considered milk "very good." Vegetables were usually buttered, and mild-flavored ones were preferred. The age, sex, place of residence, and nationality of parents influenced attitudes toward foods and determined methods of preparation of the various food items.

Contributions of School Lunch

Under the National School Lunch Program in the United States, the lunches served must meet minimum nutritional requirements prescribed by the Secretary of Agriculture on the basis of tested nutrition research. A pattern known as the Type A Lunch was devised to provide, roughly, one-third of the daily nutrient

allowance for the median-age child--that is, the child from 10 to 12 years--as recommended by the National Research Council (Mirone and Harvey, 1954).

The school lunch pattern (Velat et al., 1951) developed to meet the requirements of the Type A Lunch calls for the following foods: 1/2 pint of whole milk as a beverage; 2 ounces of lean meat, poultry, fish, or cheese, or one egg, or 1/2 cup (cooked measure) of dry beans, peas, or soybeans, or 4 tablespoons of peanut butter; 3/4 cup of vegetables or fruit or both; one or more portions of bread or muffins or other hot bread made of whole-grain or enriched flour or cereal; 2 teaspoons of butter or fortified margarine. It is permissible to meet the protein requirement by serving one-half the quantities of each of two protein-rich foods.

A number of investigations to determine the nutritional value of school meals and their contribution to the total daily food intake have been made. Meyer et al. (1951) analyzed meals served to children in fifteen schools in seven different localities and found that Type A meals, including milk to drink, did not provide generous amounts of ascorbic acid and thiamine, two of the nutrients in which family diets are also frequently found to be low. Seventy meals were analyzed. Scarcely half provided one-third of the Recommended Allowances for ascorbic acid and even fewer provided adequate thiamine.

Of nine schools studied by Driesbach (1947), lunches provided less than one-third of Recommended Allowances for energy value in four schools, for calcium in six schools, for thiamine in five

schools and ascorbic acid in only one school. Four of six schools showed deficits in minerals and vitamin A, but all furnished more than one-third of the Recommended Allowances for riboflavin for those children who accepted milk.

Stiebeling (1950) stated that when a cross-section of city families was surveyed in the spring of 1948 by the Bureau of Human Nutrition and Home Economics about two in ten families had less than the recommended amounts of ascorbic acid, thiamine, riboflavin, and niacin when some allowances were made for average losses in cooking. Maryland school children who ate lunch at school and lived in the country had their purchased food supplemented by home-grown vegetables and fruits which improved the nutritional value of their diets. The school lunch tended to complement customary diets in the community. Milk, green and yellow vegetables, and tomatoes and citrus fruit were served more often in school lunches than in home meals.

Tansil (1945) reported on the growth rates of 1600 Negro children in a thickly populated district of New York. The children who came from families on relief were given a free school lunch estimated to contain from one-third to one-half of the Recommended Allowances of nutrients. Ten comparisons of five age groups showed that children receiving the school lunch made greater gains in both stature and weight than did the corresponding groups who ate either at home or in nearby shops.

In Florida, Abbott et al. (1946) carried out a five-year study in a badly nourished rural community. During this time it was noted that the children entering school each year had the same

type of defects attributed to poor nutrition as were found at the beginning of the study. A school lunch given to the children was planned to provide at least the minimum daily allowances of essential nutrients. The incidence of many deficiency signs was determined at the beginning of the study and periodically afterwards. The authors stated that "from the data presented it may be concluded that when planned to take care of known deficiencies, and when special attention and supplementary vitamins and minerals are given as necessary, the school lunch offers an effective means of raising the nutritional status of school children."

Mack (1947), after a nine-year study of school lunches in Pennsylvania, reported that the nutritional needs of the children could be met only when someone trained in nutrition and dietetics planned the lunches carefully and when the children's home dietaries were studied and the school lunch menus designed to complement them. The Pennsylvania studies led to the conclusion that to meet the needs of the majority of the children, the meal provided at school should supply about one-half of energy, protein, phosphorus and iron requirements, two-thirds of calcium requirements and from one-half to four-fifths of those for the major vitamins, except vitamin D, which should be nine-tenths of the requirements.

In a more recent study of school children of Ohio, Kansas and Iowa, Eppright et al. (1952) found that different children had adequate diets on different days. The proportion of children in a group who maintained a continuously good diet for three or seven days might be very different from the proportion as represented by a single day. An analysis of the food consumption of the Iowa

group of children showed that the week-end habits, particularly regarding milk and meat, differed from the school-day habits. The calcium content of the diets was consequently less on the week-ends than during the school week. Failure to include the week-end days in this sample would result in an overestimation of calculated calcium and an underestimation of the calculated protein intakes of the children studied. The greatest variability in intake was in vitamin A and ascorbic acid. The day-to-day use of fruits and vegetables seemed to be more variable than other menu items.

A study of the nutritive value of the diets of 9-, 10- and 11-year old public school children of Iowa, Kansas and Ohio (Eppright et al., 1955) showed individual intakes of calcium, ascorbic acid and vitamin A to be somewhat low. At these ages, the diets of boys generally exceeded those of girls in nutrient content. Among the girls, the ratings in vitamin A value, ascorbic acid and iron intakes were better in lunch groups than in the non-lunch groups. Children with the school lunch exceeded the non-lunch children in the consumption of vitamin C-rich foods.

Cost versus Nutrition

High meal cost does not assure high nutritional value. This was confirmed by Driesbach (1947) in evaluating the cost of meals in seven consolidated-type schools with school lunch programs and two elementary schools in fairly large towns. The major cost items were food and labor. The kind of equipment used, the available kitchen floor space, the number of meals served, the number of food items served and the number of food items prepared in the

school were major factors determining the cost of labor. Food inventories showed that most of the schools bought foods which needed little labor in preparation and serving, such as canned fruits, fruit juices, vegetables, soups, fish, and meat. Commercially prepared salad dressing and various ready-mixed desserts, such as puddings, gingerbread mixes, and gelatin preparations, were also used. One school rented freezer locker space for storing farm-purchased meat. There was considerable variation in management practices among the schools, ranging from volunteered services to paid full-time managers. Only one lunchroom had a full-time manager with a degree in home economics.

Augustine et al. (1950) calculated the per caput food costs on the basis of purchased food and total food used to determine daily food costs. These included cost of the purchased food, the value of the federal commodities used, and labor costs. The nutritional adequacy of the lunches was considered in terms of calories, protein, calcium, iron, vitamin A, thiamine, riboflavin, niacin, and ascorbic acid. A study of nutritional adequacy of lunches served to three grade groups revealed that the adequacy of the lunches decreased as the age of the students in each group increased. The first group usually had the greatest selection of food items whereas the last group often had less selection and smaller portions. The authors stated that there seemed to be some direct relationship between the cost of lunches and the nutritional adequacy. To serve adequate lunches at a minimum cost, careful planning is needed to include low-cost foods of high nutritive value. Equal care is necessary to avoid high-cost foods

of poor nutritional value.

Two field studies were conducted by Nelson (1950) to discover whether the price mechanism could be adopted by the nutritionist as a means of directing student food choices. In the Lincoln and Roosevelt High Schools of Des Moines, Iowa, the demand for white cake was studied. Marshalltown was chosen for a study of green beans (a popular vegetable) and beets (an unpopular vegetable). The great elasticity of demand for white cake indicated that the price mechanism could be used to curtail purchases. If other pastry items should have similar elasticities, then the price mechanism could be used effectively to decrease their purchase, and thus stimulate the sales of fresh fruit, custards, ice cream or other items containing essential nutrients. When the price of beets was dropped from 5 cents to 4 cents per serving, the per cent of the students taking beets increased 2.4 per cent. This would mean one more sale if 300 students had passed through the line. Other unpopular vegetables might not respond sufficiently to price changes to justify price manipulation. A price drop would attract increased purchases of a popular vegetable such as string beans, but probably not enough to justify a price drop. A price drop of 20 per cent, from 5 cents to 4 cents, would result in approximately a 10 per cent increase in sales--about 6 additional sales in a student population of 300. An increase in price of 33.3 per cent to 8 cents would result in a decline of sales for string beans of 33.3 per cent, according to the author. This would mean that in a student population of 300, the sales would drop from 29 at 6 cents to 19 at 8 cents. The author further stated

that the results of his study should be interpreted with caution.

An interesting study of adult food costs in relation to nutrition was made in Louisiana by Moore et al. (1947). Seven-day diet records were obtained from 90 white and 69 Negro women who were pregnant. Their incomes ranged from below $750 to over $2000. In a study of the food habits of these women, the authors found that in the income brackets studied, poor diets did not disappear with increased income. Bad food habits and lack of knowledge of relative food values were deemed responsible for this. Several women in income groups over $5000 per year did not have dietary ratings superior to women in lower income brackets, although their food included many expensive items. The percentage of good diets, however, did increase in the higher income brackets. None of the women in the low-income groups (below $1000) had diets which were rated poor or very poor, although approximately 20 per cent with incomes above $1500 were rated as receiving poor diets.

Dietary Surveys

A dietary survey gives important information and is one of the most satisfactory methods of obtaining a picture of the dietary pattern of any particular locality. The Committee on Nutrition Surveys (National Research Council, 1949) said that in making dietary surveys, two aspects of the time period covered seemed especially important: (a) the difference among seasons, and (b) the day-by-day and week-by-week variability in diet quite apart from seasonal change. Whether or not it would be desirable to calculate a given nutrient in a diet depended on whether or not

it was likely to be deficient and on the intercorrelation of nutrients. For example, many studies have shown that it was safe to assume that if calcium and protein were adequately supplied, phosphorus also would be provided in sufficient quantity.

Eppright et al. (1952) discussed some problems in collecting and interpreting dietary information about groups of children and presented the results of a preliminary study made to help solve them. They stated that objectives determine the size and organization of the sample, the method of collecting and evaluating data, the duration of the study, and many other conditions. Dietary studies as described by them showed the kinds of foods eaten, the distribution of foods among meals, and the estimated intake of nutrients. The results obtained were more accurate in describing groups than individuals. Any one combination of three days during the week could represent the week-day intake as accurately as another, but week-end food habits were likely to differ from those of the school days. The probability of seasonal influences in nutrient intake, particularly of ascorbic acid, must be remembered in interpreting data.

Bosley (1947) in describing surveys made in North Carolina of the dietary habits of school children 9 to 11 years of age stated that the three days used were always selected from the middle of the week to avoid the unusual meals that might occur on Saturday, Sunday, or Monday. Ordinarily, the surveys were made in the autumn and in the spring when fresh garden produce was not plentiful and families during these months relied on markets and on canned foods. Bosley further stated that 9- to 11-year-old children

were selected because the type of information needed seemed to be more accurately submitted by them. Most children in this age range were able to recall easily the foods eaten over a 24-hour period. Below 9 years, children had some difficulty remembering what they ate for supper on the preceding day. Above 11 years of age there was evidence of the well-known tendency of children to seek the approval of adults. Children beyond 11 years of age had acquired enough information about the foods they should eat to influence their reports, although it might not have influenced their food habits.

The accuracy with which children are able to report all food eaten and to estimate the quantity has often been questioned. Meredith et al. (1951) designed a study to obtain some indication of the accuracy of the recall of school children and to find some of the errors which might commonly occur. Three nutritionists and one school lunch supervisor conducted the project. A total of 94 children in a rural school, ranging in age from 9 to 18 years, participated. Sixty-three of the children were between 9 and 12 years old. The study covered three consecutive days, with a different group of children participating each day. A record of actual consumption and a record of consumption by recall for one school lunch was obtained for each child. One nutritionist measured and weighed standard portions of food. The lunchroom supervisor checked the food on the tray when the child stopped at the cashier's desk to pay for his lunch. Cards which listed all the food items on the menu for the day were used for this check. These cards were numbered at the top and the bottom and perforated

so the bottom could be removed and put onto the tray of food. The child was instructed to leave the card on the tray when it was returned to the "turn-in window" at the end of the meal. A teacher wrote the child's name on the top part of the card. In this way any left-over food on the tray could be recorded on the bottom part of the card and the two sections matched for the "computed" record. Soon after lunch, the children checked that day were interviewed by a nutritionist who had not eaten lunch at school and who had no knowledge of the menu served. The record made was the "recall" record. The recall and computed records agreed completely in number, kind, and quantity in only 6 of the 94 records. Bread, margarine and stuffed celery were foods most often omitted on recall.

SOURCES OF MATERIALS

Subjects

There were 348 students enrolled in grades 1 to 6 in the Woodrow Wilson School, Manhattan, Kansas, where a Type A School Lunch was served according to the standards of the National School Lunch Act and the recommendations of the State Board of Education, Topeka, Kansas. Of these students enrolled, 188 ate lunch at home or in restaurants or carried a sack lunch to school. There were 160 who stated that they ate in the school lunch room more often than not. Most of the data collected for this study were obtained from the latter group of students.

Three groups of 25 students each were selected as subjects for

testing three vegetables: broccoli, asparagus, and Brussels sprouts. The subjects were chosen from lists of boys and girls who liked or did not like the vegetable studied. The composition of these taste panels by vegetables tested and by grade distribution, sex and preferences of the students is shown in Table 1.

Table 1. Distribution by sex and preferences of children serving on taste panels.

Vegetable	Grade	Like		Do not like		Total
		Boys	Girls	Boys	Girls	
Broccoli	1	1	1	-	-	2
	2	3	1	3	2	9
	3	1	1	1	1	4
	4	1	1	-	-	2
	5	-	-	-	6	6
	6	2	-	-	-	2
Total		8	4	4	9	25
Brussels sprouts	1	-	1	-	-	1
	2	3	1	1	3	8
	3	1	2	2	-	5
	4	2	2	2	-	6
	5	-	-	-	-	0
	6	3	1	1	-	5
Total		9	7	6	3	25
Asparagus	1	1	1	2	-	4
	2	4	1	1	2	8
	3	-	1	1	1	3
	4	1	-	1	2	4
	5	1	-	1	-	2
	6	1	1	-	2	4
Total		8	4	6	7	25

Some of the children were automatically eliminated from these groups because of absence from school during one or more of the

five times during which each of the vegetables was tested. For broccoli, two fifth-grade girls in the "do not like" group and one third-grade boy and one sixth-grade boy in the "like" group were eliminated, leaving a total of 21 subjects completing the test. In the "do not like" group for Brussels sprouts, one second-grade girl and one fourth-grade boy were eliminated. One second-grade boy, one third-grade boy and one sixth-grade boy were eliminated from the "like" group for that vegetable, leaving a total of 20 students to complete the test. Only one third-grade girl in the "like" group was eliminated from the group of 25 for testing asparagus.

Three samples of 10 children each were chosen for testing preferences of cooked vegetables cut into three shapes. Vegetables used for this test were green beans, carrots and potatoes. The group, consisting of approximately equal numbers of boys and girls, was distributed by grades as follows:

Vegetable	Grade	Total
Beans	1	5
	2	4
	3	1
Carrots	3	5
	6	5
Potatoes	4	4
	5	2
	6	4
		30

A group of 10 children, representative of those eating the school lunch, was chosen to complete a five-day dietary record of

foods eaten other than the school lunch. These included foods eaten at breakfast, dinner and snacks. The group consisted of two boys and two girls in the 7- to 9-year-old group, three girls and two boys in the 10- to 12-year-old group and one girl 13 years old. These records were made in order to get an over-all picture of the dietary pattern for the children to determine whether or not the contribution of the school lunch could be considered adequate.

Methods of Obtaining Data

Permission to do the present study was obtained from the supervisor of the Manhattan School Lunch Program and the principal of Woodrow Wilson School. The principal informed all teachers as to their part in the study. Teachers designated times at which surveys could be made in their rooms.

Various forms (Appendix) were used during the study which gave the following data:

Form I: Tabulation of vegetables used in school menus. A copy of the school lunch menus as served during the months of October, November, December, February, March and April was obtained from the school lunch supervisor. This form was used to tabulate the kinds of vegetables served, their methods of preparation, and the number of times each vegetable was used during the six months. Vegetables familiar to the children were learned from this data.

Form II: Food preferences. This listed 22 cooked vegetables and 13 raw vegetables usually obtainable in the Manhattan area. Each vegetable was numbered in a column and underlined for easy identification. To the right of each vegetable were three spaces or "boxes" in which the children could mark their preference of "like," "do not like" or "have not tasted" for the vegetable as it was named. A picture of each vegetable was shown to the children as it was named to aid in identification. Vegetable preferences of the children were tabulated from this information.

Form III: Vegetable acceptance work sheet. This was used to determine the total amounts of vegetables prepared, size of servings, number of servings accepted, amounts of vegetables left at end of serving period and the total plate waste of these vegetables.

Form IV: Individual acceptance of foods served. This form was used to tabulate vegetables by method of preparation and their acceptance by the children determined by plate waste at the completion of the meal. The numbers on the form represented pins numbered to correspond which had been used to identify the children whose vegetable preferences were known. (Table 1.) This was used to test the three least-known vegetables--broccoli, Brussels sprouts and asparagus as determined by the initial questionnaire, Form II.

Form V: Food acceptance. Tabulation of "what they say" versus "what they do" was made on this form from the data collected on Form IV. Five tabulations were made for each of the three vegetables tested.

Form VI: Instruction sheet for food records. This form was given to fifteen mothers visited who agreed to assist their children in keeping a five-day dietary record of foods eaten other than the school lunch. These records would include breakfast, dinner and snacks.

Form VII: Food eaten. Five of these sheets were given to each of fifteen children for recording their food intake during the five days chosen for their dietary record. A tabulation of this information was made to learn whether or not these foods added to the school lunch eaten would provide adequate diets for these children.

Form VIII: Vegetable shape preference. This sheet was used to tabulate vegetable preferences according to shapes, and included statements to aid in interpreting the results.

The school principal accompanied the writer and assisted in making all surveys in the school situation. At the time designated, the writer was introduced by the principal to the teacher and students of a particular grade or room. Then the principal explained briefly to the children what they were to do as their part of the project. Copies of Form II were given the children by

the principal who remained in the room to assist while the questionnaire was being completed by the group. The teacher and students were then thanked for their cooperation and time given to the study. This procedure was followed for each of 10 groups of children surveyed.

Data Obtained

In order to gain some knowledge of what vegetables had been served in the school lunch room, and to learn which vegetables should be familiar to the children eating lunch in the school lunch room, a tabulation of these was made on Form I for the fall and spring months. This information was used to determine vegetables previously not served that could be added to the school lunch menus.

An initial food preference survey (Form II, Appendix) was made during the first week of April, 1955, followed by a final survey six weeks later. The initial survey was used to learn which vegetables were least known to the children. From this information, three vegetables were chosen for testing. The survey was also used to determine which vegetables were liked and which were not liked by individual children. The children were grouped according to their preferences, then 75 children were chosen from these groups for testing (Table 1). The final survey was made as a re-check to determine changes in food preferences of the children.

A vegetable acceptance work sheet (Form III, Appendix) was used as a basis for determining the size of portions served and

whether or not these portions were consumed by the children. This information was used in calculating the nutritive value of the school lunches as served. It also served as a check to determine food acceptance and portion control for future meals.

Individual acceptance of foods served (Form IV, Appendix) determined whether or not the children actually accepted vegetables as they had stated on the questionnaire (Form II, Appendix), or if acceptance depended on methods of preparation or the influence of other individuals in the near vicinity during meal time. Campaign type pins were painted blue and numbered from 1 through 25 with red finger-nail polish. These pins were used to identify children who had said they either liked or did not like the particular vegetable being tested. During the lunch hour, the principal called the names of designated individuals from compiled lists of preferences. The child whose name was called would raise his or her hand and a pin corresponding to the child's number would be given to that child to wear during the lunch hour. At the end of the meal plate waste determined the amount of vegetable which had been eaten. The pin was removed from the child and answers were recorded to the following questions: Did you like the vegetable? Would you like to have it again soon? (or if there was plate waste) Did you taste the vegetable? Would you taste it if served again soon? Sometimes when several children who had been sitting at the same table returned plate waste, the child wearing the pin would be asked, "Did your friends like the vegetable?"

Food acceptance sheets (Form V, Appendix) were used to

tabulate the information collected by the use of Form IV. Plate waste was checked as 1, 2, 3 or 4 quarters of a whole portion. All waste portions rated 2 or below were checked as vegetable accepted and interpreted to mean that the portion which had been served was too large for the child to consume. All portions rated above 2 were checked as vegetables not acceptable to the child. Vegetables rated as 4 were often untasted by the child. This method of interpreting acceptability was used to compile four-way tables of acceptance.

In order to get an over-all picture of the dietary pattern of the children, food records (Forms VI and VII, Appendix) were kept by 15 children representing a sample of the students participating in the school lunch program. Five of these food records were not used in the final analysis of food intake for the group of children because they represented either brothers or sisters of the final 10 chosen, or the records were not complete in every detail necessary for tabulation. The data collected were used to determine the nutritive value of the foods eaten other than the school lunch and to determine whether or not these children were actually consuming an adequate diet. The nutritional status of other school children could be determined by this sample of children. The records were kept by the children during five consecutive days chosen from the 12th to the 22nd of April.

The nutritive value of school lunches and children's daily diets were calculated by using values found in Agriculture Handbook No. 8 (Watt and Merrill, 1950), and in the "Short Method of Dietary Analysis" of Leichsenring and Wilson as found in Turner

(1952).

To learn the effect of shapes on acceptance of vegetables (Form VIII, Appendix) three vegetables which had been marked on the initial questionnaire as being most generally accepted were chosen for testing. These vegetables, green beans, carrots and white potatoes were purchased fresh from a local market. Each vegetable was washed, cleaned and cooked whole in a small amount of water. When tender, the water was drained from the vegetable, which was then cut into the desired shapes. A small amount of salt and butter was added to the juice, which was reheated and poured over the vegetable. Hot milk was added to the potatoes instead of the potato water. After a short time for reheating, the vegetables were lifted from the juice, placed on a plate and served to the children being tested. It was believed that in using this method of preparation all shapes of the vegetable should taste alike.

Three groups of 10 children were selected by the school principal to act as subjects for testing shapes of vegetables. Each child in a group was given a plate on which one serving of a vegetable cut into three different shapes had been placed, and was also given the part of Form VIII which pertained to that particular vegetable. Each child put his grade number at the bottom of the form and placed an "x" on one of the four lines representing his choice.

DISCUSSION OF RESULTS

Vegetables Served in School Lunch

Vegetables served in the school lunch during the fall months of October, November and December and the spring months of February, March and April are listed alphabetically in Table 2. There were 52 lunches served during the fall months and 60 served during the spring months. Asparagus, broccoli and Brussels sprouts were not added to the school menus until after the first survey of food preferences (Form II, Appendix) was made during the first week of April. Dry and kidney beans were included in the list because these vegetables, usually considered as protein supplements, were often served in the home as a vegetable when the main dish was meat in some form. Cauliflower was used raw in a vegetable salad during April but was not served cooked at any time. Raw vegetable salad was most often a combination of lettuce, celery and cabbage. Shredded carrots were sometimes added to these salads. Raw carrot strips, buttered green beans, lettuce wedges, mashed potatoes and raw celery strips were the vegetables appearing most frequently on the menus. Of these five vegetables, carrots, celery and potatoes were served in such mixed dishes as beef pie, goulash, soup and stew. Carrots and celery were not served cooked in any other form. Green beans were served buttered only. White potatoes were served 54 times during the 112 meals and included 14 methods of preparation. Corn was served only 11 times but included four methods of preparation. Beets were included only as pickled beets, and these were served three times.

Table 2. Vegetables served in school lunches during two three-month intervals.

Vegetable	Method of preparation	Times used: Fall	Spring	Total
Asparagus	buttered	-	1	1
	creamed	-	1	1
Beans, dry	baked	1	-	1
	boiled	-	2	2
	boiled with ham	2	-	2
Beans, kidney	in salad	-	2	2
Beans, green	buttered	5	8	13
Beans, lima	buttered, frozen	-	2	2
Beets	pickled	1	2	3
Broccoli	buttered	-	1	1
Brussels sprouts	buttered	-	1	1
Cabbage	buttered, cooked	1	2	3
	cole slaw	4	3	7
	salad with carrots	1	-	1
	salad with pineapple	3	2	5
	wedge	2	5	7
Carrots	salad with cabbage	1	-	1
	salad, goldenglow	3	2	5
	salad with raisins	3	3	6
	raw, in strips	7	8	15
	raw, with relishes	2	2	4
	in goulash	1	2	3
	in soup	4	2	6
	in stew	2	2	4
Celery	salad with apple	3	1	4
	salad with gelatin	-	1	1
	raw, in strips	4	6	10
	stuffed with peanut butter	3	4	7
	raw, with relishes	2	2	4
Corn	buttered whole	2	2	4
	in chowder	-	1	1
	creamed	1	3	4
	scalloped	2	-	2

Table 2 (concl.).

Vegetable	Method of preparation	Times used		
		Fall	Spring	Total
Lettuce	in salad	-	1	1
	in salad with egg	1	-	1
	in sandwiches	1	2	3
	wedge	5	8	13
Peas	buttered	3	4	7
	creamed	2	3	5
	in salad	-	1	1
Potatoes, sweet	candied	1	-	1
Potatoes, white	au gratin	1	-	1
	baked	3	-	3
	in beef pie	-	1	1
	boiled	2	1	3
	browned	-	1	1
	chips	1	2	3
	creamed	1	2	3
	in goulash	1	2	3
	in hash	2	3	5
	mashed	7	5	12
	salad	-	3	3
	scalloped	2	4	6
	in soup	3	3	6
	in stew	2	2	4
Sauerkraut	hot	1	1	2
Spinach	buttered	3	3	6
	with egg slices	1	1	2
	raw, in salad	-	1	1
Tomatoes	raw, sliced	1	-	1
Turnips	mashed	1	-	1
Vegetable salad	raw	3	4	7

Cabbage wedges, to which children added salt, and cole slaw were each served seven times; but buttered cooked cabbage was served only three times. Lettuce was used for wedges 13 times, in

sandwiches three times, and in salads twice. Salt was added to the wedges by the children. Salad dressings were not used.

Canned tomatoes were probably added to stews and soups during the months tabulated; however, there was no way to determine accurately their use in these mixed dishes. They were not served alone, hot or cold, as a vegetable.

In analyzing the previous usage of vegetables in the school lunch menus, as served, it was found that prior to the initial survey made of food preferences of the children, green beans, cabbage, lettuce, peas, spinach, carrots and sweet potatoes were used as leafy, green and yellow vegetables. Tomatoes and raw cabbage were used as "other high vitamin C foods," and potatoes, beets, celery, corn, sauerkraut and turnips for "potatoes and other vegetables." Vegetables which had not been included in the school lunch menus which were available in the vicinity were broccoli, asparagus, Brussels sprouts, green lima beans, squash and parsnips. The results of this study seemed to indicate that the green vegetables, asparagus, broccoli and Brussels sprouts, should be chosen as the vegetables least familiar to the children.

Preferences of Vegetables

Foods Liked in Order of Preference. Results of the initial and final surveys of vegetable preferences (Table 3) indicated that of the 35 vegetables listed, only one vegetable, corn, remained at the same rank in both surveys. It was liked by 155 of the 160 students surveyed. The greatest change in preference was in broccoli,

Table 3. Vegetables reported as liked by school children. (160 subjects)

Initial survey		Final survey	
Vegetable	Liked by	Vegetable	Liked by
Carrots, raw	155	Corn	155
Corn	155	Carrots, raw	153
Lettuce	152	Celery, raw	149
Green beans	150	Potatoes, white	147
Celery, raw	147	Peas	145
Potatoes, white	143	Lettuce	144
Peas	141	Tomatoes, raw	143
Tomatoes, raw	141	Green beans	142
Radishes	136	Radishes	139
Carrots, cooked	135	Carrots, cooked	128
Cabbage, raw	123	Cabbage, raw	127
Beets, cooked	120	Sweet potatoes	123
Cucumbers	120	Cucumbers	119
Sweet potatoes	118	Beets, cooked	117
Tomatoes, cooked	114	Sauerkraut	116
Sauerkraut	111	Spinach, cooked	116
Spinach, cooked	111	Tomatoes, cooked	110
Lima beans, green	101	Lima beans, green	104
Cabbage, cooked	100	Beets, raw	98
Celery, cooked	96	Cabbage, cooked	97
Hominy	94	Hominy	96
Beets, raw	93	Green peppers, raw	91
Green peppers, raw	84	Celery, cooked	83
Green peppers, cooked	80	Turnips, raw	82
Onions, cooked	80	Asparagus	79
Turnips, raw	79	Onions, cooked	79
Cauliflower, cooked	71	Broccoli	75
Cauliflower, raw	67	Cauliflower, raw	75
Turnips, cooked	66	Brussels sprouts	71
Asparagus	65	Turnips, cooked	70
Spinach, raw	60	Cauliflower, cooked	69
Squash	57	Green peppers, cooked	66
Brussels sprouts	49	Squash	62
Broccoli	40	Chinese cabbage	60
Chinese cabbage	36	Spinach, raw	59

which showed an increase in acceptance of 88 per cent; it was liked by only 40 students initially and by 75 students finally. Acceptance of Brussels sprouts increased 45 per cent (from 49 to 71 students), and that of asparagus 22 per cent (from 65 to 79). The 10 best-liked vegetables in order of composite preference were:

corn, raw celery, lettuce, white potatoes, green beans, carrots (cooked and raw), peas, radishes and raw cabbage. These are all standard vegetables found in local markets; and, with the exception of celery, all are garden vegetables of the community. Two-thirds of the vegetables were liked by over half of the children. The 10 vegetables least liked included seven strong-flavored vegetables and spinach, asparagus and squash. Thirteen vegetables lost in preference and 21 gained during the final survey.

Foods Disliked. Vegetables disliked by the children are listed in Table 4. Cooked onions were disliked by the most children (71) in the initial survey but asparagus was disliked by the most children (68) in the final survey. Brussels sprouts and broccoli were among the 10 most disliked vegetables in the final survey but not in the initial survey. The 10 vegetables most disliked in the initial survey again included seven strong-flavored ones, and spinach, asparagus and squash. In the final survey, broccoli and Brussels sprouts were added to the top 10.

Of the 35 vegetables listed, not one was liked by all of the children. The same 10 vegetables that were liked best were included in the vegetables disliked by the least number of children. Only raw celery, raw tomatoes, radishes and cucumbers did not change in number of children who disliked them during the six weeks from the initial survey to the final survey. The first three of these were included in the 10 best-liked vegetables, and cucumbers were not in season during the survey although they could have been purchased in local stores at rather high prices. It is unlikely that many cucumbers were purchased during the six weeks

Table 4. Vegetables reported as disliked by school children. (160 subjects)

Initial survey		Final survey	
Vegetable	Disliked by	Vegetable	Disliked by
Onions, cooked	71	Asparagus	68
Green peppers, cooked	67	Onions, cooked	64
Cauliflower, raw	64	Brussels sprouts	63
Cauliflower, cooked	63	Broccoli	62
Green peppers, raw	61	Cauliflower, raw	62
Asparagus	60	Cauliflower, cooked	61
Turnips, cooked	60	Green peppers, cooked	60
Spinach, raw	58	Turnips, cooked	59
Squash	55	Cabbage, cooked	56
Cabbage, cooked	53	Spinach, raw	54
Sauerkraut	46	Squash	52
Spinach, cooked	45	Green peppers, raw	50
Turnips, raw	45	Turnips, raw	46
Lima beans, green	41	Beets, raw	44
Sweet potatoes	37	Lima beans, green	43
Beets, raw	36	Spinach, cooked	38
Broccoli	36	Sauerkraut	37
Tomatoes, cooked	36	Tomatoes, cooked	35
Hominy	35	Celery, cooked	34
Beets, cooked	34	Beets, cooked	33
Cabbage, raw	33	Hominy	32
Brussels sprouts	27	Sweet potatoes	31
Celery, cooked	27	Carrots, cooked	30
Cucumbers	25	Cabbage, raw	27
Carrots, cooked	23	Cucumbers	25
Radishes	19	Chinese cabbage	21
Chinese cabbage	18	Radishes	19
Peas	17	Green beans	15
Tomatoes, raw	13	Lettuce	14
Green beans	10	Tomatoes, raw	13
Potatoes, white	10	Peas	12
Celery, raw	9	Celery, raw	9
Lettuce	8	Carrots, raw	7
Carrots, raw	3	Corn	5
Corn	3	Potatoes, white	5

between surveys that would have changed the preferences for this vegetable. While four vegetable preferences did not change, dislikes for 15 vegetables were decreased and dislikes for the remaining 16 were increased.

Foods Not Tasted. Table 5 lists the 35 vegetables and the number of children reporting those they had not tasted. Green beans and lettuce were the only two vegetables all of the children said they had tasted at the time of the initial survey. Green beans were served twice and lettuce was served four times in the school lunch during the six weeks between surveys, but three children said they had not tasted green beans and two said they had not tasted lettuce when the final survey was made. The 160 children in both surveys were the same children and the surveys were conducted in the same manner each time. The same set of pictures was used in both surveys to aid in identifying vegetables.

With the exception of asparagus, squash, beets and turnips, the 10 vegetables most often not tasted in the initial survey list were vegetables which were not usually grown by local market gardeners. Celery was known as a raw vegetable by all except four of the children but 37 children reported they did not know it as a cooked vegetable although it had been used in stews and soups at various times in the school lunch.

Broccoli had not been tasted by 84 children during the initial survey. The following six weeks, broccoli was served five times in the school lunch but in the final survey 23 children reported they had not tasted it. Of the 61 children who had tasted this vegetable for the first time during the six weeks, 35 liked the vegetable and 26 disliked it as shown by the changes in Tables 3 and 4. During this period, asparagus and Brussels sprouts had also been served five times each in the school lunch. Of 22 children who first tasted asparagus during this period, eight said they

Table 5. Vegetables reported as not tasted by school children. (160 subjects)

Initial survey		Final survey	
Vegetable	Disliked by	Vegetable	Disliked by
Chinese cabbage	106	Chinese cabbage	79
Broccoli	84	Spinach, raw	47
Brussels sprouts	84	Squash	46
Squash	48	Celery, cooked	43
Spinach, raw	42	Green peppers, cooked	34
Celery, cooked	37	Hominy	32
Turnips, raw	36	Turnips, raw	32
Asparagus	35	Turnips, cooked	31
Turnips, cooked	34	Cauliflower, cooked	30
Beets, raw	31	Brussels sprouts	26
Hominy	31	Broccoli	23
Cauliflower, raw	29	Cauliflower, raw	23
Cauliflower, cooked	26	Green peppers, raw	19
Lima beans, green	18	Beets, raw	18
Cucumbers	15	Onions, cooked	17
Green peppers, raw	15	Cucumbers	16
Green peppers, cooked	13	Tomatoes, raw	15
Tomatoes, cooked	10	Asparagus	13
Onions, cooked	9	Lima beans, green	13
Cabbage, cooked	7	Beets, cooked	10
Potatoes, white	7	Potatoes, white	8
Beets, cooked	6	Cabbage, cooked	7
Tomatoes, raw	6	Sauerkraut	7
Radishes	5	Cabbage, raw	6
Sweet potatoes	5	Sweet potatoes	6
Cabbage, raw	4	Spinach	6
Celery, raw	4	Tomatoes, raw	4
Spinach, cooked	4	Green beans	3
Sauerkraut	3	Peas	3
Carrots, cooked	2	Carrots, cooked	2
Carrots, raw	2	Celery, raw	2
Corn	2	Lettuce	2
Peas	2	Radishes	2
Green beans	0	Carrots, raw	0
Lettuce	0	Corn	0

disliked it and 14 said they liked it after tasting it. Of 58 children who tasted Brussels sprouts for the first time, 22 liked them and 36 did not. This vegetable was the strongest flavored of the three tested and made the least gain in favor--38 per cent of the number tasting Brussels sprouts for the first time. Asparagus

gained in favor 64 per cent and broccoli gained 57 per cent.

Vegetable Acceptance as Measured by Plate Waste. A record of weighed plate waste (Table 6) was kept for some of the vegetables served during March, April, and May. The number of students eating the school lunch varied from 105 on May 20, to 160 on April 13. The largest amount of plate waste was 2550 grams of broccoli, and the smallest amount was 47 grams of celery sticks. The latter was served with carrot sticks for a total of 112 grams of plate waste.

The 10 best-liked vegetables (corn, raw celery, lettuce, white potatoes, green beans, carrots cooked and raw, peas, radishes, raw tomatoes, and raw cabbage) which were served during this period all had plate waste under 1000 grams. The portions of these vegetables were larger than those of less-liked vegetables (Table 4).

Acceptance as measured by plate waste was much better for buttered than for creamed vegetables. Plate waste was 1090 grams for buttered asparagus and 1470 grams for creamed asparagus. The plate waste was 13 per cent of the amount served for buttered asparagus and 18 per cent for creamed asparagus; this represented a 35 per cent increase in plate waste. Plate waste was very much lower for peas, being 520 grams or 4 per cent of the amount served when buttered and 690 grams, or 6 per cent when they were creamed. However, the amount of plate waste for creamed peas was still 33 per cent higher then for buttered peas. Plate waste for buttered broccoli was 1440 grams, or 21 per cent of the amount served. Plate waste for creamed broccoli was 1700 grams or 22 per cent of

Table 6. Acceptance of vegetables on school lunch menus.

Date	Vegetable	Amount pre-pared	Amount not served	Number served	Average size portion	Plate waste
		gm		each	gm	
March						
28	Lima beans	6810	480	132	50	1140
29	Green beans	11463	150	137	50	320
30	Spinach	16684	360	135	120	900
April						
1	Lettuce wedge	4540	370	137	30	105
4	Creamed corn	12258	908	142	80	478
5	Peas	11917	160	140	85	520
5	Cabbage wedge	6356	0	140	45	600
6	Carrot sticks	2497	0	148	15	65
6	Celery sticks	2043	0	148	15	47
7	Green salad	3518	360	141	20	500
12	Lettuce wedge	7050	550	150	45	268
13	Broccoli	6810	330	160	40	900
14	Green beans	13166	181	150	85	330
15	Lima beans	6810	783	148	40	1250
19	Asparagus	9080	395	144	60	1090
19	Cabbage salad	13166	0	144	90	630
21	Brussels sprouts	5448	665	146	35	823
22	Creamed peas	11917	200	138	85	690
22	Carrot salad	2724	840	138	15	637
25	Stew, beef	28034	908	133	205	2043
25	Green beans	9193	479	133	65	160
25	Celery sticks	5400	360	133	40	190
27	Creamed asparagus	9080	730	140	60	1470
May						
2	Creamed broccoli	9080	1248	138	55	1700
3	Creamed peas-carrots	11610	80	151	75	1280
4	Brussels sprouts	6356	65	147	45	2550
5	Asparagus with sauce	9080	602	145	60	1510
9	Broccoli	9080	2100	141	50	1440
11	Asparagus	9080	350	134	65	620
12	Brussels sprouts	8172	2270	146	40	1200
16	Broccoli	8172	1350	127	55	1730
16	All other plate waste	--	--	--	--	1930
20	Brussels sprouts	5448	1135	105	40	910
23	Asparagus salad	7377	440	107	65	1250
24	Broccoli with sauce	6356	440	109	55	2060
24	All other plate waste	--	--	--	--	2070
25	Brussels sprouts	5448	0	134	40	1320
25	Corn	9193	0	134	70	200

the amount served. Plate waste for creamed broccoli was 18 per cent more than for buttered broccoli. The total acceptance of this vegetable was poor.

Relation Between Reported Preference and Actual Acceptance of Vegetables. To determine the reliability of the paper-and-pencil survey of vegetable preferences, Chi-square was used to test the significance of relationships between the children's initial stated preferences and their actual acceptance of vegetables as served.

Chi-square values for asparagus are listed below for data collected from 24 children:

Preference for asparagus versus acceptance of asparagus	Chi-square values
Buttered (a)	1.6977
Creamed	0.2157
With cheese sauce	0.2157
Buttered (b)	2.9010*
In salad	1.6977

* Indicates relationship was significant only at the 10% level.

The relationship between the stated preference for asparagus and its actual acceptance approached significance only when the form of the vegetable was clearly recognizable. There was no significant relationship when asparagus was hidden or camouflaged by sauces. Asparagus in these various forms was actually accepted by 19 to 21 of the 24 children in the sample.

Chi-square values for broccoli are listed below for data collected from 21 children:

Preference for broccoli versus acceptance of broccoli	Chi-square values
Buttered (a)	2.0069
Creamed	6.3899*
Drawn buttered	3.2263
Buttered (b)	6.3899*
With cheese sauce	1.2886

* Indicates relationship was significant at the 2% level.

Acceptance of creamed broccoli and one service of buttered broccoli was significantly related to the child's stated preference for broccoli. Broccoli in its various forms was accepted by 12 to 16 of the 21 children in the sample. There is some indication that the time sequence was more important than method of preparation; each time it was served the acceptance decreased.

Chi-square values for Brussels sprouts are listed below for data collected from 20 children:

Preference for Brussels sprouts versus acceptance of Brussels sprouts	Chi-square values
Buttered (a)	1.5556
Drawn buttered (a)	5.9340*
Buttered (b)	3.5164
Drawn buttered (b)	5.9340*
Lemon buttered	1.5556

* Indicates relationship was significant at the 2% level.

Brussels sprouts in the various forms were accepted by 15 to 17 of the 20 children of the sample. Brussels sprouts served with drawn buttered sauce were least acceptable and showed most significant relationship to previously stated preferences. This would indicate that children who said they disliked Brussels sprouts ate them when they were plain buttered but not when they were in sauce.

Changes in Reported Preference Between Initial and Final Survey. In the final survey of food acceptability, four of the children marked the questionnaire for asparagus as "like" when previously they had marked it "dislike". During the five times that asparagus had been served, three of these children ate their portions, said they liked it, and did not have plate waste for it. The fourth child said she did not like asparagus the first time it was served to her, but she ate all of the portion. Two children reported they liked asparagus on the initial survey and did not like it on the final survey. One of these ate his portion all five times served and said he liked asparagus. The other child left over half of four portions, but accepted buttered asparagus.

One child reported she disliked Brussels sprouts on the initial survey and proved the statement correct by refusing to eat them all five times that they were served. On the final survey, she marked the questionnaire, "Have not tasted". Two children who at first "disliked" Brussels sprouts reported they liked them on the final survey. One of these ate them each time that they were served, the other, all of the times except one--the first time they

were served. Three children changed from "like" to "dislike" during the six weeks. One of these children had eaten Brussels sprouts each time they were served except once when they were overcooked. Another ate them each time, except the last time when they were served with lemon butter. However, each time he said he did not like them. The last one of the three repeatedly left plate waste each time Brussels sprouts were served.

In the final survey of broccoli, only three changes were made: two children changed from "dislike" to "like", (one of these had eaten broccoli all five times it had been served and said he liked it; the other had eaten it each time but had said she did not like broccoli), and a boy who reported he disliked broccoli on the first survey, ate it all five times when it was served to him and said he liked it; but on the final survey, he marked his questionnaire, "Have not tasted".

Differences Among Grade Groups in Vegetable Acceptance. The vegetables disliked by the children according to grade and number of students participating in each grade during the final survey showed that some vegetableswere disliked by over half of the children in grades three, four and five (Table 7). These grades were also the only grades in which at least three vegetables were accepted by everyone. Peas were the only vegetable liked by all of the sixth graders participating. The first graders, as a group, tended to dislike fewer vegetables than did the older children.

One girl in the sixth grade listed only the following likes: lima beans, green beans, peas, white potatoes, sweet potatoes and spinach. All other vegetables, cooked and raw, were listed as

Table 7. Vegetables reported disliked by five or more of 160 subjects. (Final survey)

Vegetable	Grades						Total
	1	2	3	4	5	6	
Asparagus	4	14	11	13	11	15	68
Onions, cooked	3	13	12	12	10	14	64
Brussels sprouts	5	10	12	10	11	15	63
Broccoli	3	11	11	10	10	17	62
Cauliflower, raw	8	8	6	8	14	18	62
Cauliflower, cooked	5	14	8	9	11	14	61
Green peppers, cooked	6	11	8	10	9	16	60
Turnips, cooked	4	13	4	9	10	19	59
Cabbage, cooked	2	9	11	9	10	15	56
Spinach, raw	2	10	5	7	10	20	54
Squash	4	10	6	6	9	17	52
Green peppers, raw	5	12	5	11	7	10	50
Turnips, raw	4	12	4	7	10	9	46
Beets, raw	5	10	4	7	8	10	44
Lima beans, green	5	7	4	8	10	9	43
Spinach, cooked	1	7	3	6	9	12	38
Sauerkraut	3	10	4	9	4	7	37
Tomatoes, cooked	2	5	6	6	4	12	35
Celery, cooked	2	7	3	5	6	11	34
Beets, cooked	3	7	4	5	4	10	33
Hominy	1	6	1	6	6	12	32
Sweet potatoes	3	9	4	5	2	8	31
Carrots, cooked	4	6	2	3	9	6	30
Cabbage, raw	4	5	3	3	5	7	27
Cucumbers	4	7	1	3	1	9	25
Chinese cabbage	7	2	1	3	1	7	21
Radishes	4	6	1	5	0	3	19
Green beans	2	1	4	5	1	2	15
Lettuce	4	3	0	2	1	4	14
Tomatoes, raw	2	4	1	1	1	4	13
Peas	1	2	2	3	4	0	12
Celery, raw	1	3	1	1	0	3	9
Carrots, raw	4	2	0	0	0	1	7
Corn	1	2	0	0	1	1	5
Potatoes, white	2	2	0	0	0	1	5
Number of students participating in grade	19	35	18	24	24	40	

disliked. However, this girl listed broccoli among the foods eaten at home during a five-day food intake. One boy in the sixth grade said he had never eaten or tasted asparagus, lima beans, beets,

broccoli, Brussels sprouts, celery, hominy, onions and sauerkraut of the cooked vegetables; and cauliflower, green peppers, spinach and turnips of the raw vegetables. He liked white potatoes, green beans, cooked cauliflower, corn, peas, cooked and raw carrots, raw tomatoes, raw celery and radishes. All other raw and cooked vegetables were listed as disliked by him.

Leverton and Coggs (1951) reported similar results in that there were many foods rich in essential nutrients which a great number of the children studied did not check as "willing to eat often". Augustine et al. (1950) found the same vegetables accepted as were generally accepted by the Woodrow Wilson school children. However, these authors found that grades 1 to 3 usually had the smallest percentage of students accepting menu items, whereas the first and second graders of the above school usually had greater acceptance of vegetables than did the older children.

Acceptance of Vegetables Cut into Various Shapes. Acceptances of three vegetables served in three different shapes are shown in Table 8. Although each group of 10 students that served as a tasting panel was told that all of the shapes of each vegetable being tested might taste alike, 50 per cent of the children stated they chose a particular shape because it tasted best; the other 50 per cent made no choices among shapes. Sixth grade as well as first grade children seemed to choose shapes that appealed to them. When green beans and carrots were served whole, and when green beans and potatoes were cut in long strips, children had a tendency to eat them first and make them their choice. Vegetables cut into round pieces were not favored. Davis (1933) reported that

children preferred foods in their natural state.

Table 8. Acceptance of three vegetables cut into various shapes. (Three groups of 10 subjects each)

Statements	Grades 1	2	3	4	5	6	Total
I like whole beans best	2	1	-	-	-	-	3
I like beans cut long best	2	-	1	-	-	-	3
I like beans cut small best	-	2	-	-	-	-	2
All the beans taste alike	1	1	-	-	-	-	2
							10
I like whole carrots best	-	-	-	-	-	3	3
I like carrots cut square best	-	-	2	-	-	-	2
I like carrots cut round best	-	-	-	-	-	-	0
All the carrots taste alike	-	-	3	-	-	2	5
							10
I like potatoes cut long best	-	-	-	-	1	1	2
I like potatoes cut round best	-	-	-	-	-	-	0
I like potatoes cut square best	-	-	-	-	-	-	0
All the potatoes taste alike	-	-	-	4	1	3	8
							10
					Total		30

Six of the 15 children who said there was a difference in the taste of various shapes preferred whole vegetables, and two others said the potatoes cut long tasted best. The fact that eight of 10 children stated that all of the potatoes tasted alike might have been because milk had been used for reheating the pieces instead of the water in which they had been cooked, as was done with the beans and carrots.

Acceptance of vegetables was influenced by their shapes. Children in this study preferred whole vegetables or long strips to vegetables cut into rounds or cubes.

Contributions of Vegetables to the School Lunch

Eight school lunch menus (Appendix B) were analyzed for nutritive values as shown in Table 9. These menus were served at school during the time 10 school lunch participants were keeping a record of the food which they ate at home for breakfast, dinner and snacks. Quantities of nutrients representing one-third of the Recommended Allowances for 12-year-old boys, (the standards set up by the School Lunch Act), are given at the bottom of the table.

Table 9. Nutritive values of eight school lunch menus.

Date 1955	Calories	Protein gm	Calcium gm	Iron mg	Vit. A I.U.	Ascorbic acid mg	Thiamine mg	Riboflavin mg	Niacin mg
April 12	915	40.0	0.57	4.3	1240	65	0.44	1.01	5.9
April 13	684	30.8	0.59	4.0	8135	42	0.28	0.73	5.3
April 14	753	22.4	0.47	3.1	1310	16	0.46	0.70	3.3
April 15	793	44.4	0.76	3.9	1064	18	0.61	0.92	11.7
April 18	925	36.0	0.49	5.0	950	63	0.67	0.80	6.5
April 19	729	29.3	0.77	4.7	3910	55	0.41	0.75	5.2
April 20	624	23.1	0.52	2.2	1000	52	0.34	0.79	2.1
April 21	800	37.9	0.76	4.8	975	77	0.37	0.77	5.6
Recommended	833	23.3	0.40	4.0	1500	25	0.43	0.60	4.3

Not one of these menus was adequate in all nutrients for a 12-year-old boy. Vitamin A values and calories were deficient in six of the eight menus. Each vitamin, except riboflavin, was low

in at least two of the menus; four were low in thiamine. Three menus were low in iron. Vegetables served on menus which werelow in vitamin A values included lettuce, green beans, lima beans and celery, kidney beans, and Brussels sprouts. Although lettuce, green beans and Brussels sprouts are classified among the leafy, green and yellow vegetables, none is a good source of vitamin A values.

Broccoli and carrot sticks, which have high vitamin A values, were served together resulting in almost enough vitamin A to supply the need for two days. Because the body is able to store vitamin A, adequacy of intakes computed on a weekly basis may be more important than meeting the requirements each day. However, in this group of menus, those with high vitamin A values did not balance those with low values.

Two menus were low in ascorbic acid as calculated; however, tomato juice used in preparing the creole spaghetti and orange juice in the orange ambrosia may have been sufficient to bring these values up to those recommended. Actual amounts of these juices were not available for calculation of ascorbic acid in the menus.

Menus low in iron contained main dishes with a low meat content and vegetables which were not excellent sources of iron.

Contribution of Home Diet to Daily Diet

Nutritive value of daily diets of 10 children is shown in Table 10. The figures in this table are averages from a total of the standard recommended nutritive value of the school lunch and the values of the food eaten at home. Children 7- to

Table 10. Nutritive value of daily diets of 10 children.

Subject and age	Calories	Protein gm	Calcium gm	Iron mg	Vit. A I.U.	Ascorbic acid mg	Thiamine mg	Riboflavin mg	Niacin mg
Girl, 7	2299	85.5	1.61	10.6	6840	88	1.17	2.37	11.3
Boy, 7	2277	74.3	1.69	10.1	3963	78	1.15	2.01	10.7
Girl, 9	2395	81.4	1.31	10.7	4709	108	1.03	1.92	12.8
Boy, 9	2577	85.7	1.73	11.7	5554	161	1.30	2.47	11.8
Recommended for ages above:	2000	60.0	1.00	10.0	3500	60	1.00	1.50	10.0
Girl, 10	2344	73.0	1.72	10.3	3417	89	1.11	1.80	9.2
Girl, 11	2531	81.0	1.59	9.9	6376	80	1.07	2.23	10.8
Girl, 11	2035	74.6	1.61	10.4	4520	89	1.04	2.09	11.1
Recommended for ages above:	2300	70.0	1.20	12.0	4500	75	1.20	1.80	12.0
Boy, 11	2658	80.9	2.20	10.8	3677	69	1.27	2.18	13.1
Boy, 12	2762	87.4	1.94	10.1	5974	102	1.29	2.71	9.6
Recommended for ages above:	2500	70.0	1.20	12.0	4500	75	1.30	1.80	13.0
Girl, 13	2316	90.0	1.66	12.1	9659	71	1.19	2.31	13.3
Recommended for age above:	2500	80.0	1.30	15.0	5000	80	1.30	2.00	13.0

9-years of age were not deficient in any of the recommended nutrients. This was also true for this age when the school lunch nutrients were considered. Of the six children between the ages of 10 and 13, all were deficient in iron and thiamine, four in niacin, and two in vitamin A, ascorbic acid and calories. Of the two low in

caloric intake, the 13-year-old girl was overweight, and the 11-year-old girl was small for her age.

Of the two children with low ascorbic acid intakes, the 11-year-old boy (No. 3, Table 11) ate only four servings of vegetables at home during five days. These included two servings of white potatoes and one serving each of lettuce and baked beans. The 13-year-old girl (No. 10, Table 11) ate 12 servings of vegetables but these were not vegetables high in ascorbic acid content.

The 10- to 12-year-old children ate the same size portions of food at home as did the 7- to 9-year-old children and by the standard set up for the younger group the older children would not have been deficient except for two, the girl 10 years old and the boy 12, in niacin content. For this sample of children, the food intake seemed to be based on the same size portions for the entire family, and nutrients supplied were adequate for children under 10 and inadequate for older children.

If the school lunch were to make up the deficiencies of the family diet as calculated from the sample represented, it would need to include extra amounts of iron, vitamin A, thiamine and niacin. However, school menus studied also tended to be low in these nutrients. Green, leafy and yellow vegetables furnish larger amounts of these nutrients than do cereal products and other vegetables and fruits. However, lean meats are excellent but usually expensive sources of iron, thiamine, and niacin. Broccoli and asparagus are good sources of these nutrients and were least known at the beginning of the study.

Table 11. Servings of vegetables eaten at home by 10 children as recorded on 5-day food intake records.

Vegetable	Child number 1	2	3	4	5	6	7	8	9	10	Total
Group I Leafy, green and yellow vegetables											
Asparagus	-	1	-	-	-	2	-	1	-	-	4
Beans, green	1	1	-	2	-	-	-	-	-	1	5
Broccoli	-	-	-	-	1	-	-	-	-	-	1
Carrots	-	1	-	1	-	-	1	-	-	2	5
Lettuce	2	1	1	-	1	1	-	-	-	1	7
Peas	1	-	-	-	-	1	1	-	-	1	4
Peas and carrots	-	2	-	-	-	-	1	-	-	-	3
Spinach	-	-	-	-	-	-	-	-	-	1	1
Green salad	-	-	-	-	2	1	4	-	1	1	9
Group II Tomatoes and raw cabbage											
Cabbage salad	-	-	-	-	-	-	-	-	-	2	2
Tomatoes	2	-	-	-	3	-	-	1	2	-	8
Group III Potatoes and other vegetables											
Potatoes, white	4	4	2	3	2	3	3	2	5	2	30
Potatoes, sweet	-	-	-	-	1	-	-	-	-	-	1
Beets	-	-	-	-	-	-	1	-	-	-	1
Celery	-	-	-	-	-	1	-	-	-	-	1
Celery-carrot sticks	2	-	-	-	-	1	-	-	-	-	3
Corn	-	-	-	-	2	1	1	1	-	-	5
Onions	-	1	-	-	-	-	-	-	-	-	1
Sauerkraut	-	-	-	-	-	-	-	-	-	1	1
Group V Dried beans and peas											
Baked beans	-	-	1	1	-	1	-	-	2	-	5
Pork and beans	-	-	-	-	-	-	-	1	-	-	1
Total	12	11	4	7	12	12	12	6	10	12	98

Relation of Cost to Nutritional Value of Vegetables

In previous studies (Eppright et al., 1952; Kennedy, 1952; Meyer et al., 1951; Velat et al., 1951; Driesbach, 1947; and Steibeling, 1950), nutrients most often deficient in school and family diets were iron, vitamin A and ascorbic acid. In the present study, diets of children were found to be deficient in these nutrients and also in thiamine, niacin and calories. Ten vegetables used to supply iron, vitamin A, or ascorbic acid are listed in Table 12. Prices for fresh, frozen and canned vegetables were obtained from three stores, a privately owned small store, a large downtown grocery and a small neighborhood chain grocery, during three months: November, January, May.

Costs of 100-gram portions of these vegetables are listed to the right of the table. The most economical vegetables on basis of cost per 100 grams were raw cabbage, carrots and squash, and canned carrots and spinach which cost less than 4 cents. The most expensive vegetables were frozen Brussels sprouts and frozen and canned asparagus which cost more than 12 cents. In the medium price range, from 5 to 10 cents per 100 grams, were green beans, lima beans, broccoli, fresh and frozen spinach and canned and frozen peas. Canned vegetables were always cheaper than frozen, but differences in price were often so small that the greater acceptance of the frozen form might make it the better buy.

Carrots, spinach, squash and broccoli were excellent sources of vitamin A values. These vegetables were also economical sources as shown in Table 13. One-third of the daily allowance of

Table 12. Cost and nutritive values of 100-gram portions of some leafy, green and yellow vegetables.

Vegetable	Iron mg	Vitamin A I.U.	Ascorbic acid mg	Cost		
				Fresh	Frozen	Canned
Asparagus	0.9-1.9	800-1040	21-23	--	$0.137	$0.122
Green beans	0.7-1.7	450- 660	5-14	0.059	0.084	0.056
Lima beans, green	1.7-1.9	180- 290	6-17	--	0.096	0.068
Broccoli	1.0-1.3	2330-3400	74-75	0.070	0.085	--
Brussels sprouts	1.3	340- 400	47-63	0.087	0.123	--
Cabbage, cooked	0.5	90	19-31	0.018	--	--
Cabbage, raw	0.5	80	50	0.018	--	--
Carrots, cooked	0.6	12500-17570	3-4	0.030	--	0.039
Carrots, raw	0.8	12000	6	0.030	--	--
Peas	1.5-1.9	670- 720	9-18	--	0.065	0.052
Spinach	2.0-3.0	6820-11780	14-59	0.085	0.070	0.039
Squash	0.6-0.8	4950-6190	5-7	0.036	0.061	--

Table 13. Cost of vegetable portions containing one-third of the daily allowances of iron, vitamin A and ascorbic acid for the 12-year-old boy.

Vegetable	Vitamin A 1500 I. U.		Ascorbic acid 25 mg		Iron 4 mg	
	Wt. gm:	Cost	Wt. gm:	Cost	Wt. gm:	Cost
Asparagus	187	$0.229	119	$0.145	444	$0.542
Green beans	333	0.186	500	0.280	571	0.320
Lima beans, green	832	0.567	416	0.283	235	0.160
Broccoli	64	0.045	34	0.024	400	0.280
Brussels sprouts	441	0.384	53	0.046	308	0.268
Cabbage, cooked	1666	0.300	130	0.024	8000	1.440
Cabbage, raw	1875	0.337	50	0.009	8000	1.440
Carrots, cooked	12	0.003	833	0.250	6666	2.000
Carrots, raw	12	0.003	416	0.125	5000	1.500
Peas	223	0.115	277	0.144	266	0.139
Spinach	22	0.009	178	0.070	200	0.078
Squash, winter	30	0.010	500	0.180	666	0.240

vitamin A value for the 12-year-old boy could be purchased for 1/3 cent in the form of 1/4 carrot 5-1/2 inches by 1 inch (12 grams). Spinach (1/8 cup, or 22 grams) and squash (1/7 cup, or 30 grams) furnished this amount of vitamin A value for 1 cent. A scant half cup (64 grams) of broccoli furnished this amount for less than 5 cents. Considering 500 I. U. of vitamin A value in a vegetable a good source of this nutrient, green lima beans, Brussels sprouts and cabbage would be considered poor sources.

One-third of the daily allowance for ascorbic acid could be provided by 1/2 cup (50 grams) shredded cabbage for less than 1 cent;

by one small stalk or 1/4 cup (34 grams) of broccoli for less than 3 cents; by 1/2 cup (53 grams) Brussels sprouts for 5 cents; and by 1 cup (178 grams) spinach for 7 cents. Other vegetables listed are not good sources of ascorbic acid because the amount required is more than the average individual could consume.

Spinach is the only vegetable that could be considered a good source of iron in the list given in Table 13. It would require 1-1/9 cups (200 grams) at 8 cents to furnish one-third of the recommended daily iron intake. All other vegetables would be too expensive and too bulky to be economical sources of iron.

Recommendations for Improving Acceptability of Vegetables

Appearance is a major factor in the acceptance of vegetables, and includes color, size and shape, and texture of portions. Children like bright colors and therefore carrot sticks are popular. Cooked green vegetables such as broccoli, Brussels sprouts, green beans and green peas are much more attractive and acceptable when their natural green color is preserved.

Size of portion often means the difference between acceptance and rejection, especially in introducing new vegetables. When small portions are given, children will usually taste the product. If there is also a clean-plate policy, they will be encouraged to eat the entire portion even though they might not like it. If the vegetable is not served too frequently, the process can be repeated. This often results in acceptance of the vegetable.

Children prefer vegetables cut in various shapes. Small whole

vegetables and long strips seem to be most popular. By serving vegetables in various shapes at different times, greater variety is given to the meal. One of the mothers interviewed very aptly stated, "I didn't like carrots as a small child because Mother always cut them into chunks".

Texture depends upon the kind and quality of the vegetable served and whether it is served cooked or raw. Cooked vegetables must be soft enough to eat but they should not be overcooked. The shape of the vegetable should be distinctive after cooking, except when served mashed such as potatoes, squash and turnips. When Brussels sprouts were overcooked, plate waste was 40 per cent; at other times plate waste for that vegetable was 17, 20, 21 and 24 per cent. Crisp raw vegetables are much more acceptable than wilted ones, and often more acceptable than the same vegetable cooked, i.e., carrots. Raw vegetables should provide a "crunchy" feeling for variety in a meal that is usually composed of soft foods. Poor quality of the vegetable, such as woody stalks of asparagus and broccoli, overripe garden peas and beans and wilted lettuce and celery, also decreases acceptance of the vegetable. Children remember a stringy, hard to eat, toughened vegetable, especially if they are tasting it for the first time, and will often refuse to taste it again at a later date.

Taste depends somewhat on the quality of the cooking. Too much salt, too many spices, a burned flavor, or a strong flavor (as in overcooked cabbage), tend to cause rejection of a vegetable. Naturally occurring strong flavors such as those present in broccoli and Brussels sprouts tend to be associated with low

acceptance.

Combinations of vegetables usually are not well accepted. Great care must be taken in presenting them so that they are not considered left-overs. The school lunch is not exempt from this consideration as was shown by the comment of one small boy who asked when stew was served the day after lima beans had been weighed for plate waste, "Did you save the beans for the stew?" Crisp vegetables mixed with soft vegetables, such as peas or kidney beans in salads, are not well-accepted by most children. Differences in textures might be the reason for this dislike, or as one teacher remarked, "When I am accustomed to having a vegetable hot, I don't like to have it served to me cold". Bread is often added to stewed tomatoes; however, when too much bread is added, the dish loses its distinctive tomato flavor and texture. Foreign objects such as orange seeds in the jello salad or sand in the spinach may cause rejection and an aversion to the food.

Attitudes of the group influence the acceptability of vegetables. When children sat at a table where the majority of the children liked a vegetable, they were more apt to eat it. The worker casually remarked to a group of children that raw cauliflower with salt on it sounded like popcorn when it was eaten. All of the children at the table ate the raw cauliflower. One girl who was a strong leader and disliked most of the vegetables tasted influenced many at her table to reject these vegetables.

Motivation through the use of taste panels was an effective method to improve acceptability of vegetables. One small girl who ate very little of the food served to her always ate the

vegetable when she wore a pin for testing purposes. Another girl who marked her initial questionnaire as "do not like" Brussels sprouts ate all five test portions and said how good they were when she returned her pin.

CONCLUSIONS

Among 160 grade school children participating in a model school lunch program, the 10 best-accepted vegetables, listed in order of preference, were: corn, raw celery, lettuce, white potatoes, green beans, cooked and raw carrots, peas, raw tomatoes, radishes and raw cabbage. The 10 vegetables least liked included seven strong-flavored vegetables and spinach, asparagus and squash.

Simple methods of vegetable preparation, such as buttering, were more acceptable than other methods using sauces. Vegetables tested were asparagus, broccoli and Brussels sprouts, which had not previously been served in school lunches.

School lunches most often failed to supply the older children with one-third of their Recommended Allowances for vitamin A, thiamine and iron. Inadequate lunches lacked leafy, green and yellow vegetables and main dishes containing adequate amounts of lean meats. Daily diets of the school children also tended to have insufficient quantities of these nutrients and ascorbic acid.

Among a group of 10 leafy, green and yellow vegetables studied, vitamin A could have been most economically supplied by carrots, spinach, squash and broccoli; ascorbic acid by shredded cabbage (or other raw forms), broccoli, Brussels sprouts and

spinach; and iron by spinach.

Conditions which promoted acceptance of vegetables were participation in taste panels; bright colors; small introductory portions; whole small vegetables or strips; minimal seasoning; tender, but firm, cooked vegetables and crisp, raw ones.

Conditions which hindered acceptance of vegetables were negative group attitudes directed by a strong leader, poor quality of vegetable as purchased and overcooking of vegetable.

Children did not know or did not like the vegetables which were found to be the most concentrated and most economical sources of vitamin A, thiamine, ascorbic acid and iron. These were the nutrients which needed to be increased in the school lunches. Therefore, a program to increase acceptance of these vegetables is needed.

SUGGESTIONS FOR FUTURE STUDY

Further development of this study would include an educational program for vegetable acceptance based on student participation and classroom choices of vegetables served. The project would include one new vegetable or one new method of preparation for each school month with one specific grade acting as group leader.

Approximately one-half hour of classroom participation would be required a week for the project. During the first week, by using the group-discussion method, a vegetable and its method of preparation could be chosen for study by the group. An assignment for the next group discussion could be information about how and where the vegetable is grown.

Pertinent information about the growth of the vegetable could be made into a short story for a classroom booklet during the second period. Information regarding the value of the vegetable as a food could be used to make additional pages for the vegetable booklet during the third week. This information should not include difficult names of nutrients which would be meaningless to the children but should stress the relationship of the vegetable to growth of children.

The vegetable chosen should be served for lunch the fourth week on the day of the discussion period. During the classroom meeting for this week, the children should decide why they like the vegetable, how they could make other dishes using the vegetable, and if it was not liked, what they might do to make the vegetable taste better.

The vegetable chosen by the grade could be given some special consideration such as, "The Third Grade Vegetable", or "Surprise Vegetable of the Month". It is believed that the school children would accept the vegetable of their choice when it was prepared and served to them. The fact, that they had a choice in the vegetable selected for their grade, would probably encourage them to eat the vegetable choice of another grade.

The pages of the booklet could be reproduced for the children in all grades. At the end of each month, the new pages could be added so that in an eight-grade school, eight vegetables or eight methods of preparation of vegetables would be included.

It would be necessary to test acceptability of vegetables at the beginning of the project and again at its completion to

determine or measure progress in vegetable acceptance.

SUMMARY

This study explored methods for improving acceptability of vegetables by 160 elementary school children who participated in a Type A lunch program in a Manhattan school. Surveys were made to determine vegetable preferences of the children at the beginning and the end of a six-week period during which three vegetables, not previously served, were introduced through the school lunch.

The 10 best-liked vegetables in order of composite preference were: corn, raw celery, lettuce, white potatoes, green beans, carrots (cooked and raw), peas, raw tomatoes, radishes and raw cabbage. Two-thirds of the 35 vegetables were liked by over half of the children, but not one was liked by all of the children. The 10 vegetables least liked included seven strong-flavored vegetables and spinach, asparagus and squash.

The greatest change in preference was in broccoli which showed an increase in acceptance of 88 per cent; it was liked by only 40 students initially and by 75 students finally.

The 10 best-liked vegetables all had plate waste under 1000 grams although the portions served were larger than those of less-liked vegetables. Acceptance, as measured by plate waste, was much better for buttered than for creamed vegetables. Children preferred whole vegetables or long strips to vegetables cut into rounds or cubes. Actual acceptance was significantly associated with previously stated preference for Brussels sprouts and broccoli

but not for asparagus, which were the three new vegetables introduced.

Of eight school lunch menus analyzed, none was adequate in all Recommended Allowances for 12-year-old boys. Vitamin A values and calories were low in six, thiamine was low in four and iron was low in three. Each vitamin, except riboflavin, was low in at least two of the menus.

Daily dietary patterns of a sample of 10 children were also low in vitamin A, thiamine, iron and niacin for the 12-year-old boy. Children under 10 years of age were not deficient in any of the nutrients.

The most economical vegetables on the basis of cost per 100 grams were raw cabbage, carrots and squash, and canned carrots and spinach, which cost less than 4 cents. The most expensive vegetables were frozen Brussels sprouts and frozen and canned asparagus which cost more than 12 cents.

Carrots, spinach, squash and broccoli were excellent sources of vitamin A values. One-third of the 12-year-old boy's daily allowance for vitamin A could be purchased for 1/3 cent in the form of 1/4 carrot, for 1 cent for 1/8 cup spinach or 1/7 cup squash, or for less than 5 cents for 1/2 cup broccoli. One-third of the daily allowance of ascorbic acid could be purchased for less than 1 cent in the form of 1/2 cup shredded cabbage, or for less than 3 cents for 1/4 cup of broccoli. Spinach could be considered the only good source of iron and would cost 8 cents for the amount required to supply one-third of the recommended daily iron intake.

In this study, children did not know or did not like those vegetables which were found to be most concentrated and most economical sources of vitamin A, thiamine, ascorbic acid and iron. These nutrients were also found to be inadequately supplied in the school lunches. Such findings pointed to the need for a program to increase acceptance of these vegetables.

A six week's program did not provide adequate time to effect much change in vegetable acceptance. A student participation program integrated into a school course of study is proposed.

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APPENDICES

FORM I

Tabulation of Vegetables Used in School Menus

Date	Vegetable	Method of preparation	Times used		Total
			Fall	Spring	

FORM II

NAME _____

GRADE _____

Do you eat School Lunch? Yes____; No____.

COOKED Vegetables	Like	Do not like	Have not tasted
1. Asparagus			
2. Lima beans			
3. Green beans			
4. Beets			
5. Broccoli			
6. Brussel sprouts			
7. Cabbage			
8. Carrots			
9. Cauliflower			
10. Celery			
11. Corn			
12. Hominy			
13. Onions			
14. Peas			
15. Green peppers			
16. White potatoes			
17. Sweet potatoes			
18. Sauerkraut			
19. Spinach			
20. Squash			
21. Tomatoes			
22. Turnips			

RAW Vegetables	Like	Do not like	Have not tasted
1. Beets			
2. Cabbage			
3. Chinese cabbage			
4. Carrots			
5. Cauliflower			
6. Celery			
7. Green peppers			
8. Cucumbers			
9. Lettuce			
10. Radishes			
11. Spinach			
12. Tomatoes			
13. Turnips			

FORM III

Vegetable Acceptance Work Sheet

Date	Vegetable served	Amount prepared in servings	Size of serving gm	Servings accepted no.	Food not consumed: Amount not served gm	Food not consumed: Plate waste gm

FORM IV

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INDIVIDUAL ACCEPTANCE OF FOODS SERVED

Date _____

Vegetable _____

Method of preparation _____

No.	Tasted	Like	Repeat	Waste
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				

FORM V

Food Acceptance

Children's likes and dislikes of vegetables as indicated by the questionnaires versus what they eat at school.

Vegetable_____

Date_____

		What they do: Ate	Refused
What they say:	Like	(a)	(b)
	Dislike	(c)	(d)

Formula:

$$\text{Chi-square} = \frac{(ad - bc)^2 n}{(a + b)(c + d)(a + c)(b + d)}$$

FORM VI

INSTRUCTION SHEET FOR FOOD RECORDS

1. Time of recording

   Breakfast: On morning of day it is eaten.
   Noon meal: On same afternoon, immediately following meal.
   Evening meal: and between meal snacks on the following morning (try writing it on paper right after eating, and bringing it to school the next morning).

2. WRITE DOWN EVERYTHING YOU PUT IN YOUR MOUTH AND SWALLOW. If you miss a meal, write the word "NOTHING" in the space for that meal.

3. TELL HOW FOOD IS COOKED - FOR EXAMPLE, FRIED OR SCRAMBLED EGG, BAKED OR MASHED POTATO, CREAMED OR BUTTERED CARROTS. IF FOOD IS NOT COOKED BUT EATEN RAW, WRITE "RAW" AFTER IT.

4. WHEN YOU EAT TWO FOODS TOGETHER, WRITE DOWN BOTH OF THEM - like this:

   1 white roll with 1 teaspoon jelly
   1/2 cup mashed potato with 1 tablespoon gravy

5. WRITE DOWN HOW MUCH YOU EAT OF EACH FOOD. Estimate quantities as nearly as possible. Record amount of bread in slices, milk in cups (c) and fruits in cups (c) where possible, sugar in teaspoons (t), meat in servings. Foods eaten in a unit as 1, 2, etc. as eggs, 1; oranges, 1 medium, etc.

6. BE SURE TO WRITE THE KIND OF FOOD YOU EAT. If you eat cereal, write oatmeal, shredded wheat biscuit, or whatever kind of cereal it is. BE SURE TO TELL THE KIND if you eat any of these foods: bread, meat, peas, beans, potatoes, soups, salads, or sandwiches -- like this:

   Soups - cream of tomato, navy bean, split pea or vegetable.
   Salads - lettuce; apple, celery and nut; tuna and celery; cabbage. (Tell kind of salad dressing if known).
   Sandwiches - 2 slices of whole wheat bread, butter, peanut butter.
   2 slices white enriched bread, mayonnaise, American cheese.
   Desserts - Chocolate cake; apple pie; Sundae; chocolate sauce with walnuts.
   Jello: orange with banana and orange slices.

7. Be SURE YOU INCLUDE SUGAR, CREAM, BUTTER, JELLY, JAM, NUTS.

8. IF YOU TAKE WHEAT GERM, COD LIVER OIL, VITAMIN PILLS, MEDICINE ETC., PLEASE LIST UNDER SUPPLEMENTS AT THE BOTTOM OF PAGE - Otherwise write the word "Nothing".

INSTRUCTION SHEET FOR FOOD RECORDS (concl.).

The following is a sample of how the record should be filled in:

BETWEEN BREAKFAST AND NOON MEAL			
"Mars" candy bar	1		
Coke (bottle)	1		
NOON MEAL			
Fried egg	1	Roast beef	1 slice
Baked white potato	1 med.		
Buttered green beans	2/3 c		
Milk	1 c		
BETWEEN NOON AND EVENING MEAL			
Sandwich: white bread with boiled ham, lettuce and tomatoes	2 slices	Sundae: chocolate ice cream with chocolate sauce and walnuts	

AFTER YOU FINISH WRITING YOUR RECORD, SEE IF YOU DID THESE THINGS:

1. Did you write down only the foods you put in your mouth and swallowed?

2. Did you write down HOW MUCH you ate or drank?

3. Did you miss a meal? If so, did you write the word "NOTHING" in the space for that meal? If you didn't eat between meals, did you write the word "NOTHING" in the space for between-meal food?

4. Do you take wheat germ, yeast, cod liver oil, etc.? If so, did you list under supplements? If not, did you write the word "NOTHING" under supplements?

FORM VII

Name_____ Date_____

School_____ Grade_____ Age_____

Meals	Food Eaten	Amount
Breakfast		
Between Breakfast and Noon Meal		
Noon Meal		
Between noon and Evening Meal		
Evening Meal		
After Evening Meal		
Vitamin and Mineral Supplements		

FORM VIII

GREEN BEANS

I like whole beans best _____

I like beans cut long best _____

I like beans cut small best _____

All the beans taste alike to me _____

I am in grade _____

CARROTS

I like whole carrots best _____

I like carrots cut square best _____

I like carrots cut round best _____

All the carrots taste alike to me _____

I am in grade _____

POTATOES

I like potatoes cut long best _____

I like potatoes cut round best _____

I like potatoes cut square best _____

All the potatoes taste alike to me _____

I am in grade _____

Appendix B

School lunch menus served during April 12-22, 1955

April 12, 13, 14, 15, 1955	April 18, 19, 20, 21, 1955
Tuesday, April 12 Orange juice Beef and gravy Mashed potatoes Lettuce wedge Bread Butter Fudge pudding Milk	Monday, April 18 Orange juice Scalloped potatoes and ham Kidney bean salad Peanut butter-honey sandwiches Ice cream Milk
Wednesday, April 13 Toasted hamburger sandwich Buttered broccoli Carrot strips Fruit cobbler Milk	Tuesday, April 19 Beef pie Buttered asparagus Cabbage, pineapple, marshmallow salad Bread Butter Fruit gelatin Milk
Thursday, April 14 Creole spaghetti Green beans Lime gelatin salad Bread Butter Butterscotch squares Milk	Wednesday, April 20 Orange juice Beanie-wienie Potato chips Lettuce wedge Bread Butter Banana cream pudding Milk
Friday, April 15 Tuna-noodle casserole Buttered frozen lima beans Celery with peanut butter Lettuce sandwiches Orange ambrosia Milk	Thursday, April 21 Barbecued beef on bun Buttered Brussels sprouts Grapefruit-lemon mold Bread Butter Honey-chocolate oatmeal cookie Milk

METHODS FOR IMPROVING THE ACCEPTABILITY OF VEGETABLES IN THE SCHOOL LUNCH PROGRAM

by

GRACE MARIAN CHESSMORE CABLES

B. S., University of Colorado, 1942

AN ABSTRACT OF A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

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Previous studies have indicated there are many vegetables, especially strong-flavored ones, that children are not willing to eat. In addition, literature has reported that school lunches tend to be low in vitamin A and ascorbic acid. Excellent sources of these vitamins are leafy, green and yellow vegetables, including many of the strong-flavored ones.

The purpose of this study was to test methods for improving acceptability of vegetables in the school lunch program, to determine nutritive values of daily diets of school children, and to determine economical vegetable sources of vitamin A values and ascorbic acid.

Subjects in the present study were 160 elementary school children who participated in a Type A lunch program in a Manhattan school. School lunch menus were tabulated for a six-month period to determine types of vegetables served and their methods of preparation. Surveys were made to determine vegetable preferences of the children at the beginning and at the end of a six-week period. During this time three vegetables not previously served on school lunches were introduced in various forms. Asparagus, broccoli and Brussels sprouts were served buttered and with cream and cheese sauces. Acceptance of each vegetable was tested by a taste panel composed of 25 children. The relationship of actual acceptance to previously stated preferences for those vegetables was determined by the use of four-way tables and Chi-square tests. Three taste panels of 10 children each were used to test the acceptance of various shapes of three well-liked vegetables: green beans,

carrots and white potatoes, presented whole or in long strips, or in cubes, small pieces or rounds.

Nutrient calculations were made on a series of eight school lunch menus, and on a concurrent series of five daily diets for 10 selected children, 7 to 13 years old. Each child's average daily diet was considered adequate if its content of calories and eight nutrients met the Recommended Allowances for his respective sex-age group, as set up by the National Research Council. School lunches were considered adequate if they furnished nutrients at levels equal to one-third of the Recommended Allowances for the 12-year-old boy.

Costs of vegetables were determined from prices at three local groceries during November, January and May.

The 10 best-liked vegetables in order of composite preference were: corn, raw celery, lettuce, white potatoes, green beans, cooked and raw carrots, peas, raw tomatoes, radishes and raw cabbage. Two-thirds of the 35 vegetables on the check-list were liked by more than half of the children, but not one was liked by all the children. The 10 least-liked vegetables were: cooked onions, asparagus, cauliflower, green peppers, squash, turnips, broccoli, spinach, Brussels sprouts and cabbage. Of these 10, seven are strong-flavored.

During the six-week program, acceptance increased 88 per cent for broccoli, 45 per cent for Brussels sprouts and 22 per cent for asparagus. Actual acceptance was significantly associated with previously stated preference for Brussels sprouts and broccoli but not for asparagus. Acceptance as measured by plate waste was much

better for buttered than for creamed vegetables. Children preferred whole vegetables or long strips to vegetables cut into rounds or cubes. Vegetable acceptance was promoted by participation in the taste panels and was hindered by negative group attitudes directed by a strong leader.

Of eight school lunch menus analyzed, none was adequate in all nutrients. Vitamin A values and calories were low in six menus, thiamine was low in four, iron was low in three, and niacin and ascorbic acid were low in two. Average daily diets of the 10- to 13-year-old children were low in vitamin A, thiamine, niacin and iron.

The most economical vegetables, those costing less than 4 cents per 100 grams, were raw cabbage, carrots and squash, and canned carrots and spinach. The most expensive vegetables, those costing more than 12 cents per 100 grams, were frozen Brussels sprouts and frozen and canned asparagus.

Carrots, spinach, squash and broccoli were excellent sources of vitamin A values. Each furnished one-third of the daily allowance of vitamin A value for less than 5 cents. Cabbage or broccoli furnished one-third of the daily allowance of ascorbic acid for less than 3 cents. Spinach furnished one-third of the daily allowance of iron for 8 cents.

Children who participated in the study did not know or did not like those vegetables which are the most economical sources of vitamin A, thiamine, ascorbic acid and iron. These are the nutrients which needed to be increased in the school lunches. Such findings point to the need for a program to increase acceptance of

leafy, green and yellow vegetables. A student participation program integrated into a year-long course of study is proposed.

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